

Application of Competency-Based Education in Laparoscopic Training

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ABSTRACT

Background and Objectives: To induce competency-based education/developing a curriculum in the training of postgraduate students in laparoscopic surgery.

Methods: This study selected postgraduate students before the implementation of competency-based education ($n = 16$) or after the implementation of competency-based education ($n = 17$). On the basis of the 5 competencies of patient care, medical knowledge, practice-based learning and improvement, interpersonal and communication skills, and professionalism, the research team created a developing a curriculum chart and specific improvement measures that were implemented in the competency-based education group.

Results: On the basis of the developing a curriculum chart, the assessment of the 5 comprehensive competencies using the 360° assessment method indicated that the competency-based education group's competencies were significantly improved compared with those of the traditional group ($P < .05$). The improvement in the comprehensive assessment was also significant compared with the traditional group ($P < .05$).

Conclusion: The implementation of competency-based education/developing a curriculum teaching helps to improve the comprehensive competencies of postgraduate students and enables them to become qualified clinicians equipped to meet society's needs.

Key Words: Competency-based education, Developing a curriculum, Postgraduate medical education, Laparoscopic surgery.

INTRODUCTION

Paralleling developments in society, the economy, and science and technology in China, individuals are paying increasing attention to their health and quality of life. Along with these developments, the medical model also has gradually changed to a biology-psychology-society-based medical approach. Because of these changes, a higher quality of medical education is required. We urgently need high-quality, practical medical personnel with solid basic skills and excellent clinical qualities, trained in the Chinese medical education system. However, traditional medical education focuses on instilling knowledge in medical students without paying enough attention to training in holistic medicinal concepts and professionalism. Many medical school graduates show a significant lack of clinical skills and work abilities.

Among the 4 typical vocational education modes at present in the world—competency-based education (CBE) of North America, dual system of German, technical and further education of Australia, and Business & Technology Education Council of the United Kingdom—the teaching philosophy of CBE may be more helpful for resolving of the aforementioned problems. Since its development >30 years ago, CBE has been widely used, particularly in North America and Western Europe.¹ Since it was introduced into the professional technical education of China through a Sino-Canada educational cooperation projection in 1992, CBE innovation had been carried out in 200 schools by the end of 1994, and some achievements have been gained. However, the experiences of the application of CBE in medical education are rare.

To improve the clinical education provided by medical schools, the Department of Minimally Invasive Surgery at the First Affiliated Hospital of Harbin Medical University, Harbin, China, introduced the teaching philosophy of CBE in 2011 and created a developing a curriculum (DACUM)

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chart for comprehensive assessments. Aiming toward improvements in the clinical practice training of postgraduate students, a new teaching model has been explored to accommodate this change.

METHODS

Subjects

A total of 16 postgraduate students who entered medical school in 2008 (10 of 10 students) and 2009 (6 students selected randomly from a total of 12 students) and were trained in the Department of Minimally Invasive Surgery at the First Affiliated Hospital of Harbin Medical University before the implementation of CBE were selected for the CBE/DACUM assessment using the DACUM chart, after 2.5 years' training and before their graduation in May 2011 and 2012. These students served as the traditional teaching group, or control group. After September 2010, improvements in the CBE teaching model were applied in 17 postgraduate students' third year of clinical training, who entered medical school in 2009 (the other 6 students of the total of 12 students) and 2010 (11 of 11 students). CBE/DACUM assessments using the DACUM chart were conducted in May 2012 and 2013, after 2.5 years' training and before graduation, with this group serving as the CBE group. All the students have undergone the graduation examination, which was based on traditional education, and their performance was also used to evaluate the effectiveness of CBE.

CBE/DACUM Curriculum Versus Traditional Curriculum

Patient care. In the traditional curriculum, postgraduates participate in the daily medical activities of their advisors during the entire process; they may attend the meeting in the morning, carry out clinical rounds, deal with new hospitalizations, carry out physical examinations, fill in medical records, change dressings, discharge patients, and participate in other tasks; and they may coordinate with their advisors in operations if possible.

In the CBE/DACUM curriculum, we aimed to enhance the students' sense of responsibility and self-motivation to learn. Under the guidance of a supervising doctor, each student was responsible for the daily management of a patient, which included understanding the patient's condition, completing preoperative examination and preparation, and completing postoperative observation and treatment as the patient's "responsible physician." Stu-

dents were encouraged to think independently and to autonomously and systemically understand the patient's condition. To gradually improve their ability, students were required to develop their own treatment plans in advance and to examine their plans under the guidance of their advisors. Possible areas for improvement included the following: understanding whether patients had risk factors associated with laparoscopic surgery, such as a history of abdominal surgery; asking whether patients were taking anticoagulants (which should be stopped 1 week before laparoscopic surgery); answering medical questions from patients; explaining treatment options to patients; notifying patients about the advantages and limitations of laparoscopic surgery; informing patients about the follow-up time after laparoscopic surgery; and explaining issues that require attention after patients are discharged.

Medical knowledge. The traditional curriculum was based on lecture-based learning: The medical knowledge of students is always confined to "instillation-like" teaching by teachers during studies on theoretical classes, and students only focus on textbooks and always neglect other knowledge beyond books; thus their practicing capabilities and innovative capabilities are not well developed. However, students are satisfied with finishing medical records and participation in operations and other tasks, and they are lacking positivity and initiative regarding their studies.

The new curriculum was based on CBE with regard to individualized education. The teaching content was determined with the needs of the students themselves in mind. Seminars and training in special skills were selectively assigned. A multimedia database and a laparoscopic surgery video library were established for students. Considering the characteristics of minimally invasive surgery, students received training in laparoscopic skills. Laparoscopy involves numerous types of specialized equipment and instruments. Our department established a new model of laparoscopic training based on the approach taken by the Chinese Medical Association. The training included "dry training" and "wet training" methods.

Similar to traditional methods, the basic operations of laparoscopic surgery include separation, cutting, sewing, and knotting. For dry training of our students, a laparoscopic training box was used, and the laparoscopic surgical environment was simulated. According to the training content, different teaching aids were placed in the box to practice separating, stitching, clamping, knotting, and performing other operations. Through this repeated technical training,

students should be able to preliminarily master basic techniques using hand-eye and hand-foot coordination.

During wet training, students followed their skillful teacher, beginning with the preparation of the surgical instruments and the connections of the machine wires. Students participated in the operation as surgical assistants after becoming familiar with the procedures.

Practice-based learning and improvement. In the traditional curriculum, graduate students are enrolled based on varied examinations starting with elementary school education; they tend to treat passing examinations of courses as their goals of studies and only put an emphasis on teaching materials, as well as key contents that their teachers mention. To achieve high scores or pass examinations successfully, to obtain the instructions of their teachers is the best shortcut to them. Therefore their teachers are still in a dominant position regarding their studies. In terms of the education system, the criteria for graduation are only related to whether the students have completed all of their courses and whether they have passed all of their examinations. As for the requirements for their “learning ability,” this has often been neglected because of lack of corresponding approaches of examination.

In the CBE/DACUM curriculum, the postgraduate students were required to continually learn and progress in clinical practice. The ward was treated as the “classroom,” the patients as the “teachers,” and the cases as the “teaching materials.” Wards are considered the best classrooms for training doctors, and bedside teaching is considered the best method of developing students’ thinking ability. “Heuristic” teaching could fully mobilize students’ interest and enthusiasm. Through regular case discussions, students were allowed to present the cases by themselves and to answer the questions raised by other students and by teachers. The benefits were 2-fold: students could find the shortcomings and deficiencies in the treatment of the cases, and their resilience and communication skills would be strengthened.

On the basis of each managed case, students could autonomously study the pathogenesis, the diagnosis and treatment principle, and the operation keys related to the disease. By watching videos and participating in surgery, their perceptions of the disease could be enhanced. Thus the management of a patient resulted in learning about a disease. The key for students was to master the self-learning method, which will contribute to continuous improvement in future practice.

Interpersonal and communication skills. In the traditional curriculum, most of the communication skills of the medical students were obtained by the instruction and influence of the advisors during the period of practice, which are lacking systematic and professional elements. After their internship, the students have no examination to assess their abilities to communicate with their patients. As a result, the students tend to pay less attention to the development of their communication ability during their internship.

In the CBE/DACUM curriculum, to improve the students’ communication skills, teachers should set an example and guide through practice. Teachers should demonstrate the special communication skills required for specific situations or special patients, such as how to inform patients and their families about “good news” and “bad news”; how to communicate in case of converted laparotomies, complications, or condition changes; and how to determine appropriate locations, tones, and expressions for communication. A role-play approach was used to stimulate student interest and improve students’ verbal and nonverbal communication skills.² Because minimally invasive laparoscopic surgery requires specialized equipment and instruments, as well as cooperation from supporting personnel, it is important to train students to communicate with nurses, operating room and anesthesia personnel, and individuals in the equipment management department.

Professionalism. In the traditional curriculum, nearly no training on the sense of responsibility and professional ethics for the students is provided. Most of the time, the medical students learn the sense of professionalism from their teachers. Such a conscious sense of responsibility is a kind of conscious action developed in an environment that is built by the society, the families, and the teachers together and in which the students grow up. Schools organize and launch forums or academic events related to medical ethics, law, and professionalism on an irregular basis, and because of a less close link to clinical practice generally, it is very hard to arouse sympathetic responses among clinical physicians; therefore few students are willing to take part in these forums and events.

In the CBE/DACUM curriculum, the medical students were encouraged to actively participate in a “famous doctors’ seminar” that helped students to open their minds by examining the life journey of well-known experts and scholars and to understand how to become good doctors. Ideally, the medical students would continue to progress with the famous doctors as their role models.

The students were required to prioritize patient interests, to be prepared to provide necessary patient services, and to respect patient confidentiality. Regardless of individual patients' financial situations, the students were required to provide the best possible medical services. In addition, they were asked to actively participate in various social activities and to contribute their knowledge and skills to the health and welfare of the community, thus helping to promote health care and the equitable allocation of limited resources.

The students were instructed to continually improve the quality of medical services through lifelong learning, to seek innovations in scientific knowledge, and to ensure the reliability of knowledge.

Evaluation of Competency Based on CBE/DACUM

As to the evaluation based on the curricula, the graduation examinations of the graduate students were based on the traditional curricula. The main parts of such examinations include examinations of theories, knowledge, and clinical skills before graduation. The examinations of theories and knowledge are written examinations that are taken in a concentrated manner; the examinations mainly focus on basic theories and knowledge and the abilities to analyze and solve problems. During the clinical skill examinations, the students should conduct surgical procedures independently and answer questions about the diagnosis and treatment of common surgically treated diseases. The scores for different parts are put together and calculated based on a certain weight to determine the final score.

As to the evaluation based on CBE/DACUM, first, a research team composed of 4 minimally invasive surgical specialists and 2 postgraduate education management experts was formed. Next, the "comprehensive competencies" required for minimally invasive surgery were identified. On the basis of the 6 comprehensive competencies defined by the Accreditation Council for Graduate Medical Education and the American Board of Medical Specialties, the first 5 competencies were selected for development in this study and were assigned a code ranging from A to E.

The next step was the decomposition of the comprehensive competencies. An in-depth analysis was performed to determine which specific competencies should be included in each of the comprehensive competencies. In this study each comprehensive competency was divided into 7 specific competencies, coded using the numbers 1 through 7, under the corresponding comprehensive competency. Considering the characteristics of both clinical

education and minimally invasive surgery, our research team developed the DACUM chart shown in **Table 1**.

The final step was the teaching analysis. On the basis of the analysis of the DACUM chart and the specific competencies, the learning curriculum was designed and developed.

According to the DACUM chart developed by our research team, the student was evaluated in the clinical environment by an advisor, other doctors in the department, classmates, family members of the patients, and nurses based on the 360° assessment method and was tested in the laboratory environment by examiners and standard patients based on a standardized multiple-station test method (**Table 2**). The scores for the 5 competencies were statistically analyzed, and a comprehensive score for the 5 competencies was obtained.

For example, in the evaluation of medical knowledge, advisors will carry out evaluations during daily work of students using B₁, B₂, B₃, B₄, B₅, and B₇ for a total score of 30. In the unified multiple-station examinations, the 2 examiners at the first station will ask the standard patients to mimic the symptoms and physical signs according to a case drawn from the item bank. The students are required to perform inquisition and physical examinations, and the examiners will raise questions about diagnosis, differential diagnosis, and therapeutic programs, as well as other questions, and they will carry out evaluations according to B₁, B₂ and B₃ for a total score of 30. The standard patients also carry out evaluations according to B₂ for a total score of 10. In the examinations at the second station, the students will be examined on urethral catheterization, dressing changes, and other basic operations, as well as saturation, knotting, and other operation skills and laparoscope simulation operations, according to B₄, B₅, and B₆, for a total score of 30 according to the results of sortition.

Statistical Methods

The data were processed with the SPSS statistical package (version 13.0; IBM, Armonk, New York) and presented as mean \pm standard deviation. The differences between groups were evaluated by use of analysis of variance. The comparisons between the 2 groups were made using the Student-Newman-Keuls test. $P < .05$ was considered statistically significant.

RESULTS

As shown in **Figure 1**, in the CBE/DACUM assessment, the average score for the comprehensive assessment of

Table 1.

Assessment Chart for DACUM^a Comprehensive Competencies
Developed by Our Research Team

Competency	
A	Patient care
A ₁	Develop treatment plan
A ₂	Make ward rounds and report in morning meeting
A ₃	Find proper opportunity to ask for help
A ₄	Correctly judge disease deterioration or stability
A ₅	Reasonably control volume of infusion
A ₆	Rationally use antibiotics
A ₇	Handle multiple patients simultaneously
B	Medical knowledge
B ₁	Master related treatment guidelines for diseases
B ₂	Perform correct and systemic physical examination
B ₃	Make differential diagnoses
B ₄	Master basic operation skills
B ₅	Master basic surgical skills
B ₆	Demonstrate simulated laparoscopic operation skills
B ₇	Assist in laparoscopic surgery
C	Practice-based learning and improvement
C ₁	Demonstrate growth in knowledge through reading
C ₂	Apply principles of evidence-based medicine
C ₃	Conduct literature searches and apply to treatment of patients
C ₄	Demonstrate growth in knowledge through full use of information technology
C ₅	Participate in clinical teaching to achieve improvements in both teaching and learning
C ₆	Use online medical services through Internet
C ₇	Assess and apply clinical evidence
D	Interpersonal and communication skills
D ₁	Respond promptly to work assigned by supervisor
D ₂	Provide feedback to supervising physician
D ₃	Coordinate different technical opinions
D ₄	Communicate with patients using easy-to-understand language
D ₅	Provide informed consent to patients before operation
D ₆	Communicate empathetically
D ₇	Provide patient education
E	Professionalism
E ₁	Protect patients' privacy
E ₂	Treat patients equally
E ₃	Appropriately resolve demands of patients

Table 1.

Continued

Competency	
E ₄	Demonstrate punctuality
E ₅	Assist colleagues with extra work
E ₆	Coordinate and equitably allocate limited resources
E ₇	Pay attention to cost-effectiveness ratio and attempt to reduce patients' burden

^aDACUM = developing a curriculum.

the CBE teaching group was significantly improved compared with that of the traditional teaching group (84.5 ± 6.1 versus 73.4 ± 5.9 , $P < .05$). The improvements in the 5 comprehensive competencies were also significant ($P < .05$): patient care (86.5 ± 5.9 versus 76.4 ± 5.3), medical knowledge (84.9 ± 6.6 versus 72.7 ± 6.2), practice-based learning and improvement (85.6 ± 4.9 versus 76.8 ± 5.9), interpersonal and communication skills (85.1 ± 6.9 versus 72.7 ± 7.4), and professionalism (80.3 ± 6.4 versus 68.6 ± 4.7). Analysis of the performance on the traditional graduation examination also exhibited an obvious elevation in scores (81.7 ± 7.2 versus 72.8 ± 8.5 , $P < .05$).

DISCUSSION

A number of studies have suggested that CBE is a feasible teaching method for fostering student initiative and self-study abilities,³ with additional opportunities for development. Although CBE originated in vocational education, its application in the medical profession has been increasing in recent years, and some individuals even refer to this specific application as competency-based medical education.⁴ However, there are still many problems: Chinese students spend much time on the traditional teaching mode of lectures, most of the students are lacking active self-studying habits, and their initiative for study is relatively poor; moreover, teaching expenses, the number of students, and the comprehensive qualities of students also restrict the generalization of the CBE teaching mode. Therefore, considering the actual teaching situation in China, this study first piloted the clinical training of postgraduate students based on the clinical teaching of minimally invasive surgery to explore the applicability of CBE in the medical profession.

Chinese society requires postgraduates trained in medical schools not only to have high levels of education but also to have "compound" and "practical" personal skills,⁵ all of which impose substantial requirements on medical edu-

Table 2.Weight of Score of Each Evaluator and Each Item and Construction of Score Chart for Assessment of Competency According to CBE/DACUM^a Methods

Evaluator	No. of Evaluators	Score	Score Per Item	Item
A. Patient care				
Advisor	1	35	5	A ₁ , A ₂ , A ₃ , A ₄ , A ₅ , A ₆ , A ₇
Doctor	2	35	2.5	A ₁ , A ₂ , A ₃ , A ₄ , A ₅ , A ₆ , A ₇
Examiner	2	15	2.5	A ₁ , A ₅ , A ₆
Nurse	2	15	2.5	A ₃ , A ₄ , A ₇
B. Medical knowledge				
Advisor	1	30	5	B ₁ , B ₂ , B ₃ , B ₄ , B ₅ , B ₇
Examiner (station 1)	2	30	5	B ₁ , B ₂ , B ₃
Examiner (station 2)	2	30	5	B ₄ , B ₅ , B ₆
Standard patient	1	10	10	B ₂
C. Practice-based learning and improvement				
Advisor	1	35	5	C ₁ , C ₂ , C ₃ , C ₄ , C ₅ , C ₆ , C ₇
Examiner	2	50	5	C ₁ , C ₂ , C ₃ , C ₄ , C ₆
Classmate	2	15	2.5	C ₁ , C ₄ , C ₆
D. Interpersonal and communication skills				
Advisor	1	35	5	D ₁ , D ₂ , D ₃ , D ₄ , D ₅ , D ₆ , D ₇
Doctor	2	15	2.5	D ₁ , D ₂ , D ₃
Nurse	2	15	2.5	D ₁ , D ₂ , D ₃
Patient	3	30	2.5	D ₄ , D ₅ , D ₆ , D ₇
Classmate	2	5	2.5	D ₃
E. Professionalism				
Advisor	1	35	5	E ₁ , E ₂ , E ₃ , E ₄ , E ₅ , E ₆ , E ₇
Doctor	2	10	2.5	E ₄ , E ₅
Nurse	2	20	2.5	E ₄ , E ₅ , E ₆ , E ₇
Patient	2	25	2.5	E ₁ , E ₂ , E ₃ , E ₆ , E ₇
Classmate	2	10	2.5	E ₄ , E ₅

^aCBE/DACUM = competency-based education/developing a curriculum.

cation. The CBE model can meet these requirements to a certain extent.⁶ The CBE core concept of competence is not the concept of capacity in psychology, nor can it be simplified merely as operating ability.⁷ Instead, the “competence” in CBE refers to comprehensive vocational capability.⁸ Therefore clinical education should be based on the following 6 comprehensive competencies developed by the Accreditation Council for Graduate Medical Education and the American Board of Medical Specialties⁹: patient care, medical knowledge, practice-based learning and improvement, interpersonal and communication skills, professionalism, and systems-based practice. Because this study was conducted in only 1 discipline of

minimally invasive biliary surgery, it was difficult to assess systems-based practice; therefore the other 5 competencies were selected for our study. To better implement and assess these 5 comprehensive competencies, a DACUM chart was developed for quantitative study.

DACUM is a systemic approach to determine the comprehensive competencies and the corresponding special skills required for a profession through task analysis.¹⁰ By use of a 2-dimensional DACUM chart, a professional curriculum can be developed for the comprehensive competencies and the corresponding special skills required for a certain profession.¹¹ The implementation of DACUM gen-

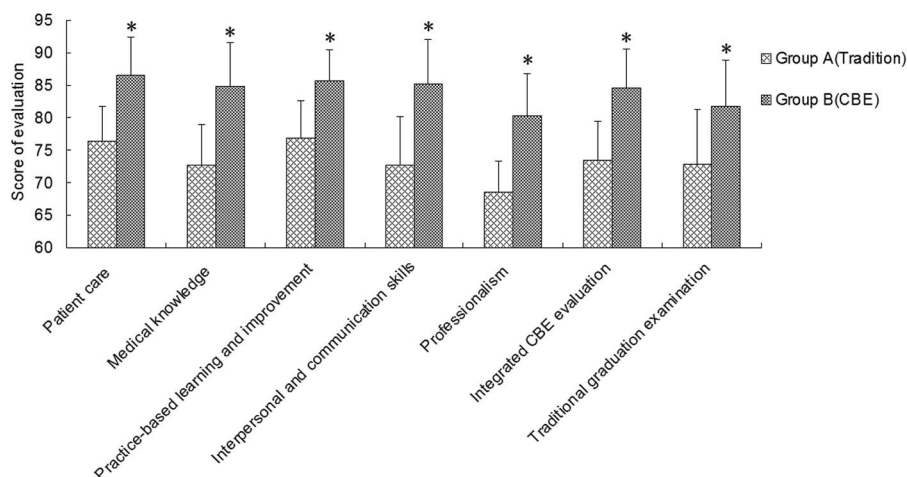


Figure 1. Assessment results of comprehensive competencies for competency-based education (CBE) teaching group and traditional teaching group. Asterisks indicate $P < .05$ compared with group A (tradition).

erally includes the following steps: establishment of a curriculum development team, investigation and analysis of courses, determination of the comprehensive competencies, decomposition of the comprehensive competencies, development of the DACUM chart, analysis of the specific competencies, preparation of the new teaching contents, teaching implementation, and teaching assessment and feedback. The CBE/DACUM teaching mode has become a relatively prevailing professional technical education mode all over the world, but it has been carried out in medical education in China only recently.

In the clinical practice of the Department of Minimally Invasive Surgery at the First Affiliated Hospital of Harbin Medical University, the comprehensive competencies were summarized as the following 5 aspects: patient care, medical knowledge, practice-based learning and improvement, interpersonal and communication skills, and professionalism. For these competencies, the DACUM chart was applied to develop specific implementation measures and the corresponding assessment criteria. The assessment results indicate that after the introduction of CBE teaching, the students' performances were significantly improved in all 5 comprehensive competencies.

Regarding the training of the patient care competency, the students were assigned the role of responsible physician under the supervision of their advisor. Because medicine is a practical science, the required knowledge and skills cannot be fully obtained from textbooks. In a traditional teaching model, students follow their teachers through passive learning. Students learn whatever the teachers choose to teach, and teachers can only instill additional

knowledge through the force-feeding method of teaching. Conversely, with the CBE concept, students become the subject of learning. The responsible-physician role enhances their sense of responsibility and improves their interest in self-learning. When encountering a problem, they find the solution through independent thinking, developing their abilities and continuously improving their medical practices. This study confirmed that after the introduction of CBE teaching, students' ability to manage patients significantly improved (86.5 ± 5.9 versus 76.4 ± 5.3 , $P < .05$).

The "medical knowledge" mentioned in this study not only refers to theoretical knowledge but also includes technical skill development and, more importantly, the ability to initiatively acquire knowledge.¹² Because proficiency in computer and Internet technology is an advantage of contemporary college students, students should be actively guided to effectively select information and to use information resources. Students should be required to take the initiative to solve problems while improving the "practice-based learning and improvement" competency. For example, in our clinical practice, one patient had sudden gastrointestinal bleeding 10 days after a cholecystectomy, which was diagnosed as Dieulafoy disease by an emergency endoscopy. Because this disease is rare, with no record in the textbooks, we guided the students to retrieve information through the Internet. The students searched numerous sources of information; clarified the etiology, manifestations, and treatment of this disease; and independently wrote a review. More importantly, through this process, the students became familiar with the proce-

dures of information acquisition and processing, laying the foundation for independent work after graduation.

The Fukuoka Declaration by the World Federation for Medical Education states that all doctors must learn communication and interpersonal skills. In addition, a lack of empathy (sympathy) should be considered as incompetence, which is the same as being insufficient in technology. Therefore effective doctor–patient communication skills are essential for qualified clinicians.¹³ However, training in communication skills has been a weak point in traditional medical education, and postgraduate students commonly lack a sense of collective effort. Accustomed to communicating through virtual networks, these students have less experience in face-to-face communication and cooperation in reality. Our training enables them to understand that each surgery group is a team and that only by acting in harmony and by working together can each task be completed. Thus the sense of teamwork can be subtly formed in their daily work. Training in doctor–patient communication skills is even more important. Some techniques can be taught to students through examples or “scenario demonstrations.” For example, students first learn to listen because listening is the most basic and most effective skill in doctor–patient communication. Second, the following language skills are addressed: using appropriate salutations; using clear, accurate, concise, well-organized, and easy-to-understand language; choosing kind words; and avoiding negative words. In addition, we should also pay attention to service etiquette, including smiling, which is useful in doctor–patient communication. After implementing these improvements, the communication skills assessment results of the students in the CBE group improved significantly (85.1 ± 6.9 versus 72.7 ± 7.4 , $P < .05$).

Traditional Chinese medicine emphasizes the training of the professional spirit. The traditional philosophy of Chinese medicine has been deeply influenced by Confucian ethics, which include the 3 aspects of benevolence, proficiency, and honesty. “Benevolence” refers to the qualities of being sympathetic and fraternal. “Proficiency” means possessing excellent medical skills and a strong ability to save lives. “Honesty” means equally treating all patients. However, under the influence of the modern biomedical model, for an extended period, medical science has focused only on natural human factors, such as physical lesions, whereas professionalism and ethics have been ignored. Recently, however, paralleling the rise of the society-psychology-biomedical model, individuals have realized the importance of medical professionalism. A report by the Association of American Medical Colleges

noted that physicians lacking in humanities and social science backgrounds often lack the ability to address intellectual challenges in their medical careers.¹⁴ Therefore the implementation of CBE must consider training in professionalism with equal importance.^{15,16} The Physician Charter proposed by the American Board of Internal Medicine Foundation, the American College of Physicians–American Society of Internal Medicine Foundation, and the European Federation of Internal Medicine interpreted 3 fundamental principles of medical professionalism: primacy of patient welfare, patient autonomy, and social justice.¹⁷ In this study professionalism training was integrated into the clinical practical training of postgraduates in minimally invasive surgery. The assessment results confirmed that students’ professionalism competency significantly improved (80.3 ± 6.4 versus 68.6 ± 4.7 , $P < .05$).

The comprehensive assessment results in this study indicate that after the introduction of the CBE concept, students’ comprehensive competencies significantly improved (84.5 ± 6.1 versus 73.4 ± 5.9 , $P < .05$). The results suggest that this concept can encourage students to transition from knowledge to practice and enable them to become qualified clinical personnel who meet the needs of Chinese society.

This study has certain limitations. We still have a less profound understanding of the connotations of CBE; the existing teaching and learning conditions are not sufficient; the teachers must achieve a breakthrough based on the original teaching philosophy; in addition, factors such as the teaching funds, as well as the quantity and quality of students, also restrict the application of CBE. After the construction of the DACUM assessment form during the implementation of this project, it is still necessary to increasingly enrich and improve it to enable it to be more comprehensive, objective, and effective during practice and application. The new standards for the examinations are established based on the CBE system; there may exist some subjective error when assessing students trained in the traditional curricula. However, on the whole, CBE is worth further exploring and promoting.

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